Implications of Passive Sampling Derived Concentrations of Airborne PCBs and PBDEs in Urban Indoor Microenvironments

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Introduction

Polychlorinated biphenyls (PCBs) and polybrominated diethyl ethers (PBDEs) are ubiquitous environmental contaminants that are a cause of major environmental concern because of their persistence, ability to bioaccumulate and their potential impact on human health. Although most studies consider that the vast majority of human exposure to PCBs and PBDEs occurs via the dietary pathway; application of these compounds in building materials and products employed in indoors (i.e. furniture, electronic and electrical equipment) along with elevated indoor air concentrations [1-4] and the high proportion of time spent in such environments (i.e. typically more than 90%), implies that inhalation exposures may be significant for some people. Given the relative lack of data on airborne concentrations of PCBs and PBDEs in a wide range of indoor microenvironments, this study monitors these compounds in a series of domestic and workplace indoor microenvironments frequented by the UK population using Polyurethane Foam (PUF) disks as passive samplers.

Experimental Procedures

Passive air samplers as described by other authors[5] were located at 23 different indoor microenvironments within the Birmingham and West Midlands area of the UK, including 12 homes, 10 offices, and one private car for sampling periods of between 4 and 6 weeks. To examine both seasonal trends and within-building variations in concentrations, sampling was conducted in two separate rooms within the same home/office (two homes and one office building) for 12 months. Previously described extract purification procedures were used with slight modifications for both PCBs and PBDEs[1,2]. GC/MS analysis and instrument specifications for PCBs and PBDEs were set up as described elsewhere[1,2]. The analytical method was assessed based on recoveries of surrogate/internal standards. As part of our ongoing quality control measures, the repeatability of our passive sampling and analytical procedures combined was evaluated by simultaneously deploying 5 samplers in the same domestic microenvironment. The low relative standard deviations observed for ∑PCB (7%) & ∑PBDE (18%) concentrations in this exercise demonstrate good repeatability for our sampling and analytical method. Generally, concentrations of PCBs and PBDEs in the 2 field blanks and 8 method blanks analysed were less than 5% of concentrations in samples and therefore sample data are uncorrected for blank levels. PUF disk sampling rates (R) for our target compounds were derived from our own calibration experiments (not reported here due to space restrictions). To estimate PBDE concentrations individual congener-based sampling rates were applied (1.1-1.9 m^3/day). However for PCBs, the average R values for each homologue group (Tri-CB=0.72, Tetra-CB=0.70, Penta-CB=0.9, Hexa-CB=0.99 and hepta-CB=1.27 m^3/day) were used due to the minimal variability of R values for individual isomers within each homologue group.

Results and discussion

Indoor air concentrations: The sampling locations and PCB & PBDE concentrations in indoor microenvironments along with outdoor air data from other studies are presented in Table 1. In the indoor environments studied, ∑PCB levels (sum of 63 congeners) ranged from 0.41 to 54.5 ng/m^3 (mean = 5.2 and median = 2.55 ng/m^3) and ∑PBDE levels (sum of congeners; 28, 47, 49, 66, 85, 99, 100, 153, and 154) varied from 5.1 to 1418 pg/m^3 (mean = 148.2 and median = 38.4 pg/m^3). To our knowledge, this is the first report on passive sampler-derived indoor air concentrations of PCBs. A previous study focused on highly contaminated indoor environments, reported levels of PCBs ranging from <100 to >6000 ng/m^3 (mean = 790 ng/m^3)[4]. However, our findings are in good agreement with the most spatially relevant study available for comparison, in which PCB levels between 1.1 and 69 ng/m^3 (mean =